Amendments to the Specification

Please amend the Substitute Specification filed on May 12, 2006 as follows:

At page 1 of the Substitute Specification filed on May 12, 2006, please insert the following paragraphs after the paragraph numbered [0006]. The following paragraphs were included in the Specification as filed on May 12, 2006:

The locating arrangement according to the invention therefore contains a plurality of ultrasonic transmitters strung along a path, e.g. at least three, six or nine ultrasonic transmitters. The distance between adjacent ultrasonic transmitters in the series is more than one meter. By virtue of this measure, transmitters can still be installed with a tenable outlay even along a path of up to several hundred meters. The actual measurement only ever requires the two nearest or only very few transmitters in the vicinity of the object to be located.

The determining method for determining the position is particularly simple if, in one development, the transmitters are strung along a straight section at mutually uniform distances between mutually adjacent transmitters. The calculation method is

then in particular independent of the location, i.e. always the same for different locations.

In one development, the distance has a value in the range of from three meters to one meter, in particular a value of 1.6 meters. The values mentioned are a particularly good compromise between a small number of ultrasonic transmitters, high spatial resolution and short propagation time determination.

In a next development, the transmitters are arranged along an aisle, in particular along an aisle in a factory building. Semiconductor wafers or other substrates for integrated electronic circuits are preferably processed in the factory building.

In another development, the locating arrangement contains a drive unit, which drives the transmitters in accordance with a pulsed operating mode in which ultrasonic pulses are transmitted between transmission pauses. Ultrasonic pulses are particularly well suited to the locating process.

In a next development, the drive unit works cyclically, drive signals which instigate the transmission of ultrasonic

pulses being generated for the transmitters. A cycle contains at least two sections in each of which a different portion of the transmitters is driven. By virtue of this measure, the propagation times from different transmitters can be determined successively without mutual interference. The number of sections per cycle depends on a plurality of parameters, e.g. the required repetition rate, the locating accuracy, the time required for communication, and on hardware conditions, e.g. 12 ultrasonic transmitters are connected to one drive unit, so that multiples of 12 are preferably chosen. A suitable number of cycles is e.g. 36 cycles or 48 cycles.

In a next development, the drive unit preferably contains a plurality of group drive units which in each case generate the drive signals for a plurality of transmitters depending on an input signal. The drive complexity can thereby be reduced.

In one development, at least three further US transmitters are strung along a further straight section at mutually identical distances between mutually adjacent transmitters. If the two paths lie parallel to one another, then locations in parallel aisles can be detected in a simple manner. However, a two-dimensional location detection is also possible, one coordinate

lying along a path and the other coordinate depending on the path from which locating is effected.

In one development, at least two transmitters on different paths transmit simultaneously, so that instances of influencing are precluded or greatly reduced. This can be achieved in particular if more than one transmitter or more than three transmitters or more than six transmitters, relative to one of the two paths, lie between the two simultaneously transmitting transmitters after a parallel displacement of one path to the other path.

In a next development, a region into which no ultrasonic signal of the transmitters or only a greatly attenuated ultrasonic signal penetrates lies between the two paths. The region is e.g. a further aisle between two aisles in which locating is effected. Thus, in semiconductor fabrication facilities, maintenance aisles are arranged between clean room aisles. No wafers are located in the maintenance aisles.

In one development, there are at least three further US transmitters strung along a straight main section at mutually identical distances between mutually adjacent transmitters, the

main section lying transversely with respect to at least two secondary sections, in particular at an angle of 90 degrees. As a result, locating can also be performed in a main aisle that connects the transverse aisles.

In one development, the locating arrangement contains at least three radiation receivers, in particular receivers for electromagnetic radiation, such as RF (radiofrequency) or radio receivers or infrared receivers, strung along a straight section at mutually identically distances between mutually adjacent radiation receivers. The distance between adjacent receivers is at least twice as large as the distance between adjacent transmitters. In one refinement, the receivers serve for communication with the objects to be located. The communication must be effected as rapidly as possible, with the result that ultrasound would be too slow. In one refinement, the receivers are additionally utilized for a coarse localization, reception levels being evaluated in place of propagation times. As a result, the circuitry outlay is also low in the case of the coarse localization.

In one refinement, the distance between the receivers lies in the range of from three meters and up to seven meters. As a

result, it is always possible to determine a receiver whose reception signal, with respect to a unit to be localized, is considerably greater than that of the other receivers, so that the coarse localization can be carried out simply and reliably.

If, in one refinement, the receivers are arranged on the same sections as the transmitters, then the assembly outlay is low. If one receiver is in each case arranged between two transmitters, preferably at the same distance from the two transmitters, then shadowing is low.

In one development, there are a plurality of connection units at each of which a plurality of antenna modules are operated, an antenna module preferably containing a reception antenna and a plurality of transmitters, e.g. three transmitters. In one refinement, the connection units are connected via a local data transmission network e.g. via an Ethernet. The modular construction enables easy adaptation to different spatial conditions.

In a next development, the ultrasonic transmitters and the RF antennas are fixed to a ceiling or to ceiling transverse bracing.

In one development, the locating arrangement contains at least 1000 or at least 1500 identification units which have mutually different identifications and which are arranged in the acoustic irradiation range of the transmitters. By way of example, in a factory building there are the abovementioned number of receptacle containers to be located for a plurality of substrates for integrated circuits.

The invention additionally relates to an identification unit containing a memory unit, in which is stored an identification which distinguishes the identification unit from other identically constructed identification units. The identification unit additionally contains an ultrasonic receiver, a radiation transmitter, a radiation receiver and a control unit. The control unit carries out an ultrasound propagation time measurement depending on a synchronization signal received by the radiation receiver and transmits the result toward the outside with the aid of the radiation transmitter.

In one refinement, the identification unit contains a power-saving bistable character display unit, which displays the content to be represented even after the operating voltage has

been switched off. As an alternative or in addition, the identification unit contains at least one luminous unit that can be driven via the radiation receiver, e.g. a light-emitting diode. The luminous unit identifies e.g. manufacturing units that are to be processed preferentially or particularly quickly. An identification unit currently sought can also be distinguished from other identification units by means of the luminous unit, in particular by means of a flashing luminous unit, even from several meters, thereby considerably facilitating the search even if the location is approximately known. By way of example, the identification unit sought can easily be picked out from three identification units within a radius of half a meter. The search enquiry is input e.g. via a drive unit.

The invention additionally relates to a location determining method, having the following steps:

constructing a locating arrangement comprising a plurality of ultrasonic transmitters along at least one path,

constructing at least two radiation receivers or radiation transmitters that in each case receive radiation from at least one region irradiated with sound by a transmitter,

introducing at least one identification unit into a region irradiated with sound by at least two transmitters,

carrying out an ultrasonic propagation time measurement from at least two transmitters to the identification unit and determining at least one propagation time datum,

determining a fine position of the identification unit depending on the propagation time datum,

determining a coarse position of the identification unit with the aid of at least two radiation transmitters or radiation receivers,

combining the fine position and the coarse position to form a location datum.

A powerful locating method is produced which is suitable in particular for use in semiconductor fabrication facilities.

In one development of the method, the following steps are carried out:

determining the fine position by trigonometrical calculations in a plane which contains a section in which the ultrasonic transmitters are strung and which contains the identification unit,

determining a fine position by means of only one spatial coordinate.

In comparison with a three-dimensional or two-dimensional locating process that is not always necessary, the one-dimensional locating process thus carried out can be carried out very accurately and with a low outlay.

The invention additionally relates to a batch box localization system, having a locating arrangement, which extensively detects the transport paths for a plurality of batch boxes between a plurality of manufacturing installations and locates the batch boxes with an accuracy of less than two meters or less than one meter. In particular, the locating arrangement according to the invention or one of its developments is used in the batch box localization system.

In one development, the batch box localization system

contains a communication system that outputs manufacturing data and/or transport data to output units fixed to the batch boxes.

As a result, it is possible not just to collect location information and output information during the storage time of the batch boxes, e.g. on a shelf, but to dynamically support the entire transport process. The crucial principle for this is the linear concept of the antenna and transmitter installation, in particular in the center along the longitudinal axis of an aisle or a so-called finger. By virtue of this principle, the antenna density can be reduced to an extent such that the required performance of an extensive localization and of a location-independent communication is achieved. The low antenna density makes it possible to achieve, in a synchronous communication protocol which is used between the RF antennas (radiofrequency), the ultrasonic transmitters and the identification units and in which one cycle is subdivided into fixed time segments, a time saving of more than 70 percent for the fine localization by means of ultrasound, so that 70 percent of the time remains for communication processes via radio.

It becomes possible to localize a batch box along the finger longitudinal axis to an accuracy of a few centimeters. By contrast, it is not possible to effect a position determination with regard to the position in terms of the height and the width

of an aisle or finger, i.e. a three-dimensional location indication. However, a three-dimensional location indication is not actually necessary for the directing function during transport since the accurate localization of a batch box is possible e.g. through the possibility of an optical signaling in the form of a flip dot or a flashing or continuously illuminated LED or lamp at the identification unit.

Consequently, the antenna modules that can be mounted along a geometrical line crucially increase the performance of the overall system, can be mounted in a simple manner and are largely independent of shelf rearrangements or relatively small conversions of the production building.

The invention thus solves the technical problem of planning, control, optimization and monitoring of the transport process in flexible production, in particular wafer production. The wafer boxes are transported automatically, e.g. by means of a conveyor belt, or manually, e.g. by means of transport carts. In the case of a production program oriented in customized fashion, the use of fully automatic, rigid transport systems often cannot be implemented with a tenable outlay on account of the lack of flexibility of the transport processes and the high capital

expenditure. This limitation is now overcome because both extensive localization and suitable outputting of transport directing and manufacturing information, per batch box, are carried out at any desired point in time in the transport process, with the result that controlling interventions by operators are possible at any time. This possibility is also referred to as a paperless fabrication facility. It is thus possible e.g. to transport an urgent batch through manufacturing in an uncomplicated manner.

The invention specifies, in particular, an integrated transport directing and manufacturing information system which integrates both the path stipulation for manual transport on the basis of a fine localization of the batch boxes by radio and ultrasonic technology in the entire production building and the information and routing outputting for efficient delivery or for efficient transport of the batch box to the next manufacturing operation. Communication to the operators is carried out e.g. via a radio transponder with a bistable display that is fixed to the batch box.

As explained in even greater detail further below, the system comprises e.g. the following components:

identification unit or DisTag (distance transponder, distance tag) as an active radio transponder with an integrated ultrasonic receiver for fine localization and a bistable display for displaying data,

antenna modules that are extensive and modular and contain RF antennas and ultrasonic transmitters and also integrated control devices,

data processing system or box tracking server for controlling the extensive localization and dynamic communication--comprehending the transport path--with the DisTag for information outputting of the transport directing and manufacturing information.